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*Courses of instruction are offered in the School of Hygiene, University of Montreal, and by the Division of Sanitary Engineering, Department of Health of Ontario, Toronto.

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Cultivation of Poliomyelitis Virus in Tissue Culture

VI. METHODS FOR QUANTITY PRODUCTION OF POLIOMYELITIS VIRUSES IN CULTURES OF MONKEY KIDNEY*

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THE demonstration by Enders, Weller, and Robbins[3] that poliomyelitis viruses proliferate in tissue cultures of human embryonic tissues pointed the way to the possibility of obtaining large quantities of virus in the form of cell free suspensions. Such suspensions would be of value in many studies of poliomyelitis virus. Two distinct techniques were used by Enders and his colleagues.[14, 15, 25] In the so-called "suspended-cell" technique, the tissues were minced and suspended in a nutrient medium in 25 ml. Erlenmeyer flasks. In the second method, fragments of tissue were embedded in a thin plasma clot lining a test tube. Nutrient medium was added, the tubes were placed horizontally in a mechanically driven drum, and slowly rotated. Under the conditions obtaining in these "roller tube" cultures, an abundant outgrowth of fibroblast or epithelial cells developed around each fragment, depending on the tissue.

*Aided by a Grant from The National Foundation for Infantile Paralysis Incorporated.

In the earlier work of Enders, human embryonic skin and muscle, intestine, or brain was employed as the source of tissue. It was later shown by Smith, Chambers, and Evans, that adult human testicular tissue supports virus growth.[19, 20] Testicular tissue from rhesus and cynomolgus monkeys was also found to support virus growth.[22] Testicular tissue was used widely in the studies of Melnick and his associates,[8, 13] Younger *et al.*,[28, 29, 30] and Scherer and Syverton.[18, 21] It is of particular interest that human kidney tissue has been found to support virus proliferation,[2, 15, 16, 24] and that monkey kidney also gives excellent yields of virus.[17] In the above-mentioned studies, strains representative of the three antigenic Types of poliomyelitis virus were cultivated.

Studies on the tissue cultivation of poliomyelitis virus have been carried out by our group during the past three years. It was found, for example, that the virus multiplies in cultures of human embryonic brain and cord, human embryonic kidney, post-natal tonsils, and in cultures of monkey testis, lung, kidney, and gut.[1, 5, 6, 23, 27] In our experiments, the conventional tissue culture media containing naturally occurring ingredients such as horse serum and chick or beef embryo extracts, were replaced by a synthetic nutrient, Mixture No. 199, devised by Morgan, Morton, and Parker.[10, 11] Mixture No. 199 was recently employed by Salk in the preparation of an experimental poliomyelitis vaccine inoculated into human subjects.[17] Tissue cultures in which Mixture No. 199 serves as nutrient are particularly valuable for such a purpose, as virus may be obtained in the form of a cell free suspension without the presence of antigenic material other than that derived from monkey kidney.

In anticipation that the continuation of studies similar to those of Salk will require larger quantities of tissue cultivated virus, we have examined the possibility of growing poliomyelitis virus in containers considerably larger than those used previously. It is the purpose of this report to give details of our methods of growing poliomyelitis viruses in cultures of monkey kidney tissue in rotated or rocked bottles, each containing 500 ml. or more of Mixture No. 199.

Since this work was started, Miller[9] has reported the successful cultivation of poliomyelitis viruses in cultures of monkey testicular fibroblasts embedded in a plasma clot in Roux bottles. The amount of culture medium used was 75 ml., and several changes of fluid could be made. The virus titres obtained were, however, considerably below those here reported.

Materials and Methods

Washing and Cleansing of Glassware

All glassware used in the preparation of tissue cultures was first boiled with a detergent (e.g., "Lakeseal") and, after thorough rinsing and mechanical brushing, was then immersed overnight in concentrated sulphuric acid. Thorough rinsing in tapwater, distilled water, and finally in ion-exchanged distilled water, was then carried out. Glassware used only for the preparation or holding of Mixture No. 199 was treated with dilute hydrochloric acid for four hours and then thoroughly rinsed.

Medium

Mixture No. 199 made from ion-exchanged water and containing 500 units of penicillin and 500 micrograms of streptomycin per ml. was used throughout these experiments.[10, 11] Earlier "lots" were sterilized by filtration through sintered glass filters. More recently we have found it satisfactory to filter through a Seitz filter under pressure, the particular filter used being gold plated. We have not yet determined whether Seitz-filtered Mixture No. 199 is completely comparable as a nutrient to that filtered through sintered glass, but no differences were detected in the experiments to be described.

Tissue

Kidney tissue was obtained from tuberculin-negative rhesus or cynomolgus monkeys, and chopped with scissors in Mixture No. 199 until the fragments were approximately 1 mm. in diameter. The minced tissue was washed several times with the nutrient until the supernatant was clear.

Preparation, Maintenance and Infection of Tissue Cultures

(a) *Rotated bottle cultures.* Four-litre pyrex glass bottles were used. The necks were enlarged to fit "Number 13" stoppers for greater ease in working. Fragments of kidney tissue were embedded in a thin layer of chick plasma (clotted by the addition of chick embryo extract) lining the wall of the bottle. In all instances, the percentage of tissue in relation to the volume of the medium was 0.5%. After clotting occurred, 500 ml. of the nutrient medium were added to the bottles, which were then rotated mechanically about their long axes at approximately ten complete rotations per hour. The rotating machine was housed in an incubator room maintained at 37°C. The tissue fragments were examined with a hand lens, and after three to four days, outgrowths of epithelium were observed around the fragments. After five days, these outgrowths were abundant; culture fluid was then removed as completely as possible, and replaced with a similar quantity of fresh Mixture No. 199 to which virus was added. The bottles were then returned to the rotating machine. In one experiment, 1 ml. quantities of fluid were removed daily for virus titration. An experiment was also carried out in a similar fashion in which a 20-litre bottle containing 2,000 ml. of medium was employed.

(b) *Rocked Bottle Cultures.* Approximately 5 gm. of minced kidney tissue were added to 500 ml. of Mixture No. 199 in a "Povitzky" or diphtheria toxin bottle. These are rectangular bottles with offset tooled necks and have a capacity of 5 litres. Such bottles were placed on a rocking machine previously employed in studies on the growth of *H. pertussis* in fluid culture.[4, 7] The machine was housed in an incubator room at 37°C. After one to six days, the original nutrient was replaced with 500 ml. of fresh medium, and virus was added in the form of infected tissue culture fluid. The cultures were returned to the rocking machine, and a quantity of 1 ml. of the supernatant fluid was removed daily for titration of virus content. The object of rocking the cultures was to allow the use of a greater depth of nutrient than would otherwise have been desirable.

Virus Strains Cultivated

Mahoney (Type 1) and MEF1 (Type 2) strains were cultivated. The strain Saukett (Type 3) is currently under investigation. The origin of these strains has been described in a previous publication.[26] The strain MEF1 was used in the form of tissue culture fluid representing the third subculture since receipt in our laboratory; the Mahoney strain was used as a fourth subculture.

Virus Titrations

Virus titrations were carried out by inoculating serial dilutions of culture fluids into roller tube cultures of monkey testicular fibroblasts; groups of five cultures were inoculated with each dilution. Each culture received a quantity of 0.2 ml. of each virus dilution together with 1.8 ml. of Mixture No. 199. Fibroblasts were examined for the cytopathogenic effect, and end points were read seven days after infection. Titres were expressed in terms of the dilution of the virus causing cytopathogenic changes in 50% of inoculated cultures (CPD_{50}). Kärber's method was used to calculate these end points.[12]

Nitrogen Determination

Total nitrogen contents of the supernatant fluids removed in one of the experiments in which MEF1 virus was cultivated were estimated by the micro-Kjeldahl method.

Results

(a) *Rotated Bottle Cultures.* As shown in Table I, Mahoney virus proliferated in cultures of epithelial cells from rhesus monkey kidney in rotated 4-litre or 20-litre bottles. High titres of virus were obtained in fluids removed two to four days after addition of virus to the culture. These titres are substantially higher than the titres of $10^{-2.9}$ to $10^{-3.9}$ obtained in preliminary experiments in which rhesus monkey testis was used instead of kidney.

TABLE I

Cultivation of Mahoney Virus in Tissue Cultures of Rhesus Kidney in Rotated Bottles

Capacity of bottles	Quantity of mixture No. 199 (ml.)	Weight of tissue	Virus Inoculum CPD_{50} per ml. of medium	CPD_{50} titres of culture fluids removed on following days after infection of cultures*				
				1	2	3	4	5
4 litre	500	2.5 gm. (0.5%)	2000			5.9		
	500	2.5 gm. (0.5%)		3.9	5.5	4.5		
20 litre	2,000	10 gm. (0.5%)		3.1	4.1	5.1	5.3	4.7

*Fluids titrated on day of removal by inoculation in groups of 5 roller tube cultures of monkey testicular fibroblasts, and end points expressed as negative logarithms.

TABLE II

CULTIVATION OF MAHONEY AND MEF1 VIRUSES IN TISSUE CULTURES OF RHESUS AND CYNOMOLGUS KIDNEY IN ROCKED DIPHTHERIA TOXIN BOTTLES*

Virus strain	Experiment number	Species of monkey yielding kidney	Virus inoculum		CPD_{50} titres of fluids removed on following days after infection of cultures**							
			CPD_{50} per ml. medium	Added after incubation of culture for interval specified (days)	0	1	2	3	4	5	6	7
Mahoney	1	rhesus	2,000	same day	2.9	3.0	3.1	4.3	4.5	5.5		
	2	rhesus	2,000	1	2.7	3.1	4.3	4.7	5.7	6.1	5.9	6.3
			2,000	3	2.7	4.1	5.7	5.9	5.5	5.5	5.9	6.3
			2,000	5	2.7	4.1	6.5	6.1	5.9	5.9	5.9	5.7
	3	cynomolgus	2,000	6	2.7	4.3	5.1	6.1	6.5	6.3		6.5
			10,000	6	3.3	4.5	5.5	6.1	6.1	5.5		5.9
MEF1	4	cynomolgus	600	6	2.1	3.1	4.9	5.3	6.5	5.7	5.5	5.5

*500 ml. Mixture No. 199; 1% kidney; rocked at 37°C.; fluid changed on day of infection.
**Fluids titrated on day of removal by inoculation in groups of 5 roller tube cultures of monkey testicular fibroblasts and end points expressed as negative logarithms.

(b) *Rocked Bottle Cultures.* Mahoney virus was cultivated in three separate experiments, the results of which are shown in Table II. In Experiment 1, the virus inoculum was added at the time of setting up the kidney culture. Five days after preparation and infection the titre of virus in the supernatant fluid was $10^{-5.5}$. In Experiments 2 and 3 virus was added one to six days after preparing the culture. Experiment 2 was designed to investigate the effect on virus yield of infecting the cultures of rhesus kidney one, three, and five days after preparation. The results are plotted graphically in Fig. 1. It will be seen that titres over $10^{-6.0}$ were obtained in fluids removed from all three bottles two to seven days after infection. Similar titres were obtained in Experiment 3 when cynomolgus monkey kidney was employed, these cultures being infected six days after preparation. This experiment was also designed to explore the effect on final yield of different initial virus inocula. There appeared to be no increased production of virus in the culture receiving 10,000 CPD_{50} of virus as compared to that receiving 2,000 CPD_{50}.

TABLE III

TITRE OF MEF1 VIRUS AND TOTAL NITROGEN IN SUPERNATANT FLUID FROM CYNOMOLGUS KIDNEY TISSUE CULTURES IN ROCKED DIPHTHERIA TOXIN BOTTLES (EXPERIMENT 5)*

Determination	Nitrogen and titres** of fluids removed on following days												
	before infection			after infection									
	0	3	6	0	1	2	3	4	6	8	10	12
Nitrogen (mg./ml.)	0.192	0.220	0.231	0.209	0.218	0.238	0.255	0.275	0.281	0.283	0.279	0.293
CPD_{50} titre of virus	..	..	..	..	4.5	6.1	5.1	6.7	5.9	5.3	5.7	4.1

*500 ml. of Mixture No. 199; 1% kidney; rocked at 37°C.; fluid changed on day six immediately prior to infection.
**Fluids titrated on day of removal by inoculation in groups of 5 roller tube cultures of monkey testicular fibroblasts and end points expressed as negative logarithms.

MEF1 virus was cultivated in cultures of cynomolgus kidney in similar experiments (4 and 5) and the results are presented in Tables II and III. Titres of over $10^{-6.0}$ were obtained four days after infection of the cultures. The results of Experiment 5 (Table III) would suggest that thereafter less virus was produced, although titres above $10^{-5.0}$ were obtained in fluids removed eight and ten days after infection. As shown in Table III, the total nitrogen increased from 0.192 to 0.231 mg./ml. during the six days in which the culture was incubated before addition of virus. During the period of twelve days following addition of virus, the total nitrogen increased from 0.209 to 0.293 mg./ml. Most of this increase occurred during the first four days and seemed to correspond to the period of maximal increase of virus.

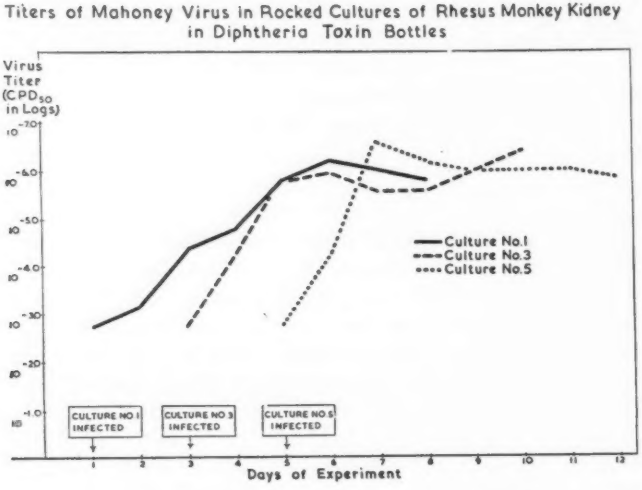

FIGURE 1
Titres of Mahoney Virus in rocked cultures of monkey kidney tissue.

DISCUSSION

The object of these experiments was to determine quickly whether substantial amounts of poliomyelitis virus could be obtained in tissue cultures of monkey organs so as to make available substantial quantities of virus for various studies. Previous work in these laboratories and elsewhere indicated that high virus titres were likely to be obtained in cultures of adult monkey kidney tissue in the synthetic medium known as Mixture No. 199. In such cultures the predominant cell type is epithelial in nature.

In cultures of monkey kidney prepared in large bottles, as an elaboration of the roller tube technique, titres of Mahoney virus of over $10^{-5.0}$ were obtained in the supernatant fluid of the cultures.

Previous experience in the preparation of pertussis vaccine[4] and of studies on the growth of Lansing poliomyelitis virus, [1, 5, 6, 23] suggested that a much

simpler culture system would be afforded by a modification of the Erlenmeyer flask technique. It was found that cultures of minced monkey kidney in 500 ml. of Mixture No. 199, contained in diphtheria toxin bottles, and rocked mechanically, supported rapid and extensive virus multiplication. When virus was added one to six days after setting up such cultures, fluids removed three or more days later had titres of approximately $10^{-6.0}$. In an experiment on the cultivation of MEF1 virus, the total nitrogen content of the fluid at the time of maximal virus production was only between 0.25 and 0.30 mg./ml. To date, substantial quantities of Mahoney and MEF1 viruses have been prepared by such methods. More recently, it has been found that the Saukett strain (Type 3) grows equally well. Evidently, the method described can be modified in various ways to suit individual requirements.

Summary

1. Mahoney (Type 1) poliomyelitis virus was cultivated in large rotated bottle cultures of rhesus monkey kidney epithelium in which the quantity of synthetic nutrient Mixture No. 199 was either 500 or 2000 ml. Virus titres, determined in tissue cultures, greater than $10^{-5.0}$ CPD_{50} were obtained in fluids removed two to four days after infection of such cultures.

2. Mahoney (Type 1) and MEF1 (Type 2) poliomyelitis viruses were also cultivated in rocked diphtheria toxin (Povitzky) bottles of rhesus or cynomolgus monkey kidney in which the quantity of Mixture No. 199 was 500 ml. Virus titres in the range of $10^{-5.5}$ to $10^{-6.5}$ CPD_{50} were obtained in the fluids removed two to seven days after infection of such cultures.

3. In an experiment in which MEF1 virus was cultivated, the total nitrogen increased from 0.209 mg./ml. to 0.293 mg./ml. When the virus titre was at its peak of $10^{-6.7}$, the total nitrogen was 0.275 mg./ml.

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Rehabilitation of the Tuberculous Patient

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DURING recent years community and governmental planning for health has been much to the fore and the rehabilitation of persons with disabilities is now considered a very important part of our whole economy.

Here in Canada the first large-scale effort in the field of rehabilitation was made for the thousands of men and women who became casualties during the second world war. Not only were these veterans entitled to every possible service to make them once again as fit as possible, but their conversion from a state of dependency to productive, useful citizens was a big contribution to our national wealth. A country's greatest potential is her man power and we simply cannot afford to leave unused and undeveloped the brains and skills of our disabled people.

Long before Robert Koch discovered the tubercle bacillus in 1882, and thus established the cause of tuberculosis, the apalling ravages of the disease and the apparent hopelessness of those afflicted were matters of deepest concern to the medical profession and all those interested in public health. With the establishment of the cause of the disease, however, both professional and lay interests began to plan its prevention and control, and during the next twenty years national associations for the prevention of tuberculosis were formed in England, Canada, and the United States of America.

Since then the fight against tuberculosis has become world-wide, but only in recent years has general recognition been given to the fact that in this battle we must of necessity treat not only the disease itself but the whole person and personality of the sufferer. In writing of tuberculosis, Dr. Patterson states that there are three facts which make it "such a stupendous world problem—its communicability, its chronicity, and its tendency to relapse or recur." Similarly there are three factors in the solution of the problem—early diagnosis, adequate treatment, and rehabilitation services.

The tremendous importance of rehabilitation in the treatment of tuberculosis is now generally acknowledged. At a recent meeting of the National Tuberculosis Association, the following resolution was presented by the Trudeau Society: "A tuberculosis control program is incomplete unless full recognition

Presented at the Maritime Conference on Social Work, held in Fredericton, New Brunswick, on June 16, 17 and 18, 1953.

is given to the importance of rehabilitation. It is therefore urged that all sanatoria and other tuberculosis control facilities organize adequate rehabilitation programs as rapidly as possible." At the same meeting Dr. Marven C. Keefer, of the Tuberculosis Control Division of the United States Public Health Service, made the following statement: "Unless complete rehabilitation services are provided, much or all of our time, money and effort to control tuberculosis will have been wasted."

With the development and general use of the x-ray in the diagnosis of tuberculosis, and the health measures adopted for its treatment, tremendous forward steps have been taken towards solving the problem, but there still remains a long way to go in our efforts to prevent relapse.

If all tuberculous patients could and would remain in sanatorium until their disease was completely arrested, the danger of breakdown would undoubtedly be greatly lessened; but many don't do this. They want to go home; they have duties and responsibilities that they feel demand their personal attention, and in some cases they feel that their stay in the sanatorium is depriving them of privileges and pleasures to which they are entitled.

The restoration to health of the man or the woman, the boy or the girl, suffering from tuberculosis depends primarily upon four things; rest, fresh air, good food, and mental tranquility. In the sanatorium, the first three requirements are assured to the patient; to create the last is the problem of the whole rehabilitation team.

Tragically, the majority of tuberculosis patients are young people at the age when inactivity is abhorrent, and so it is vitally important that some occupation be found for them. Except for the very ill, idleness is conducive not to restfulness but rather to restlessness and loss of that "tranquility of mind" essential to recovery. Occupational therapy, therefore, has been an accepted part of sanatorium treatment for a number of years, but until quite recently it was almost entirely diversional and made no contribution to the solution of the patient's economic problems to be faced after discharge. During recent years, however, occupational therapy has been very definitely part of the whole rehabilitation plan and its direction has to a great extent been changed from the diversional to the vocational.

In order best to aid the patient along his road to recovery, definite planning and preparation for his post-discharge activities must be commenced while he is still a patient in the sanatorium. A survey must be made of his background of education and experience, and also an assessment of his aptitudes and abilities. These findings taken in conjunction with his work tolerance form the basis of his rehabilitation program.

From a public health point of view, the battle is by no means won when the patient is discharged from the sanatorium. As has already been said, all too frequently he goes home before his disease is completely cured. Even should he stay in sanatorium until a state of complete arrest of the disease has been reached, the improvement in his health may be only temporary and breakdown, resulting in recurrence of danger to himself and those with whom he may come in contact, may take place.

To guard against this danger, adequate assistance must be given to restore to the patient the maximum physical, mental, social, vocational, and economic security possible. This is rehabilitation.

In rehabilitating the tuberculous, however, we achieve even more than this. Because of the relapsing nature of this disease it is vital not only to make the patient well but to keep him well—for with each relapse it is not just the health and life of the patient himself that is jeopardized but the health and life of his family, his friends and his business associates. Important as is the bringing of happiness and usefulness into the life of the patient, more important is the fact that his rehabilitation prevents the further spread of disease. It must always be borne in mind that tuberculosis is perpetuated by the transmission of the disease from one person to another, and therefore every means possible must be employed to prevent relapse and the almost certain resultant infection of other people. Actually the measures adopted to achieve the best rehabilitation of the patient do, at the same time, provide control of the disease by preventing relapse and thus eliminating the further spread.

A few moments ago I made mention of the "rehabilitation team." It is only by team work, plus the active co-operation of the patient, that rehabilitation can be achieved. The captain of the team is the doctor, and the other members are all those people within the institution who have active contact with the patient: the nurse, the occupational therapist, the school teacher, the medical social worker, and the counsellor. All have a definite contribution to make; and their knowledge of the many and diverse components in the make-up of the man, frankly discussed at the case conference, goes far towards setting the pattern for the man's rehabilitation. Because of the stress of work, the doctor rarely has sufficient time to consider with each patient his problems, his hopes and his fears; but these are disclosed to the nurse, the medical social worker, or some other member of the team, and so come to the knowledge of the doctor, to whom the information may be of inestimable value.

In a great many cases the fundamental problem with which the patient is faced is that of obtaining suitable employment upon completion of treatment. The determination of suitability rests largely with the doctor, but the occupational counsellor also has a definite part to play in assisting the patient in his selection of the best suitable job; i.e., the job best suited to his health and to his aptitudes. This selection should be made as early as possible during the patient's stay in sanatorium, and training to fit him for the selected employment should commence just as soon as approved by the doctor. For patients who will be returning to the same or similar occupations to those in which they were engaged before becoming ill, every effort should be made to have them study to increase their knowledge and improve their skills, so that they may be made more valuable employees, and thus actually profit from their stay in sanatorium.

As most patients are discharged from sanatorium before they are fit to take employment, it is most important that a careful follow-up be maintained. For those who are training to enter a new occupation, continued assistance must be given. For all there should be periodic check-ups and investigation

of living conditions. Finally, to all persons who have suffered from tuberculosis "job-placement" service should be available, to ensure their entry into "suitable" employment; thus completing their rehabilitation.

In conclusion, may I cite two cases which are typical of many that we can now close as "rehabilitated."

The first is that of a man past 40 years of age, with only a grade school education and a background of work experience in heavy labor—followed by eight years in sanatorium. During his last year and a half in hospital he studied bookkeeping with the rehabilitation instructor and was then, before discharge, enrolled for the commercial course at the New Brunswick Technical Institute. Early last summer, in competition for a Civil Service position, he placed first and is now in good, permanent employment.

The second case is that of a young French-Canadian who upon entering hospital had only a grade 7 education and no English. While a patient he learned English and completed the school work of grade 8 and most of grade 9. He was then enrolled for a year's training in bench carpentry and is now happily employed at work he likes and at which he will remain well and earn a good living.

These are Jim and François—rehabilitated, restored to a good, full life!

A Wetzel Grid Survey in Toronto

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A WETZEL GRID survey was carried out in eight schools of the University Health District in Toronto in order to determine its value and its applicability to the school health services in Toronto. No description of the Wetzel Grid itself, or of the method of using the grid, is given, since this has been adequately done in a number of other publications.[1, 2, 3, 5, 10, 14, 15]

The survey began in October, 1948, when grids were started for all the grade I children in the eight schools. A year later the children then entering grade I were added. There were 568 children in the first year and about the same number in the following year—a total of something over 1,100. A large number of families have moved from the district, and at the present time grids are being maintained for only 808 children, of whom 617 are still in the original schools and 191 are in other schools in Toronto. Children who have moved to schools outside the city have not been included in the analysis.

These 808 children form an unusual group, not at all representative of the school children of Toronto.

The sex distribution was approximately the same as that found in the general population in the same age group. Four hundred and nineteen (51.8 per cent) were males and 389 (48.2 per cent) were females.

The age distribution at the time of the first measurement is given in Table I. The majority were 6 years old, with most of the remainder either

TABLE I

AGE AT FIRST MEASUREMENT

Age (Years)	Number	Per cent
5	67	8.3
6	554	68.7
7	120	14.8
8	42	5.2
9	16	2.0
10	5	0.6
11	1	0.1
12	2	0.2
13	1	0.1
Total	808	100

5 or 7 years old. Those who were 9 years and older (3 per cent of the total) were practically all recent immigrants from foreign countries who could not speak English and for that reason were started in grade I.

TABLE II

NATIONAL ORIGIN (BY BIRTHPLACE OF FATHER)

	Number	Per cent	% stated
Canadian	276	34.2	38.5
British	52	6.4	7.3
Northern European*	33	4.1	4.6
Other European	283	35.0	39.5
Japanese	13	1.6	1.8
Chinese	15	1.9	2.1
Negro	40	4.9	5.6
Others	4	0.5	0.6
Not stated	92	11.4	
	808	100	100

*Scandinavians and Balts.

The wide variety of racial and national origins is shown in Table II. Many whose fathers were born in Canada and are therefore included under "Canadian" are of foreign extraction. About 9 per cent of the children are foreign-born, mainly displaced persons from camps in Europe; 69 (8.5 per cent) were born in Europe and 2 (0.3 per cent) in China. Nearly half (44 per cent) are first-generation Canadians whose parents were born in Europe. The majority of these are from Central Europe, mainly Poland, Russia, and the Ukraine. These various types have definite racial characteristics of body build. The Central Europeans tend to be stocky. The Northern Europeans, the Balts in particular, are usually big for their age and advanced in their physical development. Many of the Chinese and Negro children are quite thin. The Japanese tend to be of small stature in comparison with our averages. All this puts the grid to a severe test and makes the results particularly interesting.

In Table III the children are divided into Jewish and Gentile. The Jewish children comprise 38 per cent of the total. Eating habits and social attitudes tend to make many in this group overweight.

TABLE III

RELIGION

	Number	Per cent
Jewish	274	33.9
Gentile	450	55.7
Not stated	84	10.4
	808	100

It was found impossible to grade the group according to socio-economic status, but this status is very much lower than the average for the whole city. Parts of the district are slum areas. In family income, living conditions, and social standards the remainder varies from low to moderate. The majority

belong to Social Classes IV and V of the classification of the Registrar General of England and Wales.

Table IV shows the number of measurements per child. Those who have been measured regularly twice a year have had either 5 or 7 readings. Those with fewer than 5 measurements were temporarily lost and later located, usually in a school elsewhere in the city.

TABLE IV

NUMBER OF MEASUREMENTS PER CHILD

Number of Measurements	Number of children	Per cent
2	7	0.9
3	60	7.4
4	35	4.3
5	369	45.7
6	89	11.0
7	246	30.5
8	2	0.2
Total	808	100

When heights and weights were taken, the children wore ordinary indoor clothing but had their shoes off. It was felt that this was sufficiently accurate for our purpose and a great deal more convenient than having them undress. The measurements were taken twice a year, as close to October and April as possible.

RESULTS

The results obtained from the most recent set of measurements (October and November 1951) are shown in Table V.

It will be noted that in King Edward School, which is predominately Jewish, there is a definite shift to the left in the channel system, with a large

TABLE V

GRID FINDINGS, OCTOBER 1951

School	Channel									Auxodrome						
	A4	A3	A2	A1	M	B1	B2	B3	B4	U*	V	W	X	Y	Z	Total
Brant	2	4	4	6	23	5	5			5	12	14	15	1	2	49
Hester How			2		5	9	5		1		5	6	9	1	1	22
King Edward	15	11	14	29	27	27	10	1	1	15	55	44	17	1	3	135
Lansdowne	7	8	13	9	32	25	7	1	1	5	41	36	17	3	1	103
Ogden	4	1	6	22	21	19	2			6	29	26	11	2	1	75
Orde	9	4	8	6	23	9	8	1		8	23	14	19	3	1	68
Ryerson	7	4	14	16	36	24	14	1		14	30	37	26	7	2	116
Wellesley	3	2	3	8	16	12	4	1		3	16	13	11	5	1	49
Other	10	9	18	30	51	41	27	4	1	15	46	63	55	8	4	191
Totals	57	43	82	126	234	171	82	9	4	71	257	253	180	31	16	808
Per cent	7.1	5.3	10.1	15.6	29.0	21.2	10.1	1.1	0.5	8.8	31.8	31.3	22.3	3.8	2.0	
Cumulative Per cent										8.8	40.6	71.9	94.2	98.0	100.0	

*U —on or above 2% Auxodrome
V —on or above 15% Auxodrome and below 2% Auxodrome
W —on or above 67% Auxodrome and below 15% Auxodrome
X —on or above 82% Auxodrome and below 67% Auxodrome
Y —on or above 98% Auxodrome and below 82% Auxodrome
Z —below 98% Auxodrome

proportion in the stocky and obese categories. On the other hand, in Hester How, which is in one of the worst slum areas and has a large proportion of Chinese, the shift is definitely to the right.

Table VI compares our results with Dr. Wetzel's "world standards",[1] Miss Scramlin's survey in Muncie, Indiana,[2] and the recently published British Columbia Study.[3] The results of our survey are very similar to those of the B.C. study, although ours is not a representative group of the child population. Possibly the effect of the low socio-economic level is balanced by the large proportion of stocky children, which is the result of racial inheritance.

We can, therefore, conclude that our results are comparable to those found elsewhere.

TABLE VI

COMPARISON OF RESULTS OF UNIVERSITY DISTRICT SURVEY WITH OTHER SURVEYS

	University District	Muncie, Indiana	British Columbia	Dr. Wetzel
(*a*) *Physical Status*				
A4 and above	7.1	6.8	3.5	6.8
A3 and A2	15.4	15.5	11.7	9.4
A1, M and B1	65.8	59.5	69.3	61.6
B2	10.1	14.2	11.8	13.9
B3	1.1	3.5	3.3	5.9
B4 and below	0.5	0.5	0.4	2.4
(*b*) *Auxodrome*				
On and above 2% auxodrome	8.8		5.0	2
On and above 15% auxodrome	40.6		41.7	15
On and above 67% auxodrome	71.9		82.3	67
On and above 82% auxodrome	94.2		96.1	82
On and above 98% auxodrome	98.0		98.3	98

GRID APPRAISAL

Categorization of the grid records into Satisfactory and Unsatisfactory would seem to be a simple procedure, but there is surprising lack of unanimity as to the criteria by which this should be done. Dr. Wetzel treats the matter in a very general way, merely stating that "normal variations do not exceed ½ channel per 10 units of advancement"[4] and that the child's auxodrome should parallel one of the standard auxodromes. He further asserts that approximately one-third of the children will require intensive investigation.

The Department of National Health and Welfare, in its Manual on the Wetzel Grid,[5] gives the following suggestions for classification:

A—Satisfactory

B—Unsatisfactory

(a) A4's and above for obesity

(b) B2's for follow-up; B3's and below

(c) Red area laggers

(d) Blue area accelerations

(e) All irregularities

The Manual further states: "Acceptable variations in direction may amount to, but will not consistently exceed, a shift of one-half channel per 10 levels

of advancement." And: "Similarly, in the case of speed, acceptable deviations from schedule will not be more than two or three levels per year."

In the British Columbia Survey,[3] the criteria for screening as Unsatisfactory are:

(a) A4 and above
(b) B2 and below
(c) Development on or above the 2% Auxodrome
(d) Development below the 82% Auxodrome
(e) Loss or increase of more than half a channel in 10 levels of advance
(f) Acceleration or lag of more than three levels of development from the individual's auxodrome

Deisher and Bryan, in a description of their survey in King County, Wash., state:[6] "In those showing unsatisfactory growth at least one of the following conditions will be found:

(1) Failure to keep to channel with loss or gain of more than ½ channel per 10 levels of advancement.
(2) Failure to keep to level with development lag exceeding 5 levels.
(3) B3 physique or lower.
(4) Highly retarded schedules of growth (82% auxodrome or later)
(5) Irregular channel or auxodrome patterns."

They add a third category, which is called "Questionable." In this group "The child's physique and his growth show some variation from that expected but not enough to put him in the Unsatisfactory group."

Considering all these criteria carefully, it was felt that no one grouping was completely satisfactory for our purpose. The British Columbia criteria seemed unduly severe and, in fact, resulted in 40.7% of the 5,681 children being graded unsatisfactory and referred for clinical examination. A screening method which required referral for this large percentage of children would not be suitable for use in our school health program and would result in a larger rather than smaller number of clinical examinations.

In the King County survey, about 30% were found unsatisfactory—again a large percentage. Also, no mention is made of those in the A4 channel and above, which, it is felt, indicates unsatisfactory physique.

In view of these criticisms and the lack of uniformity, it was felt that special criteria should be developed for use in our school health program. Our idea was to adopt standards which would refer for examination the small percentage of children showing definitely unsatisfactory growth and development. Those whose grids were satisfactory would continue to be measured at six-month intervals. A third group of the doubtful cases would be designated for more frequent measurements, and would be re-categorized later into either the Satisfactory or Unsatisfactory group.

Considerable judgment should be used in interpreting and classifying the grids. The following general rules were followed in this survey:

1. Unsatisfactory
   (1) A4, B3 and B4 Channels
   (2) On or below the 98% auxodrome

(3) Loss or gain of 1 channel width or more per 10 levels of advancement
(4) Auxodrome lag or acceleration of 5 levels or more

2. Doubtful
(1) B2 channel
(2) On or above 2% auxodrome; between 82% and 98% auxodromes
(3) Gain or loss between ½ and 1 channel width per 10 levels of advancement
(4) Auxodrome lag or acceleration of between 3 and 5 levels
(5) Irregularity in either channel course or auxodrome

3. Satisfactory
Those showing normal Grid pattern

It will be noted that our combined Doubtful and Unsatisfactory categories correspond to the Unsatisfactory category of the Department of National Health and Welfare and the British Columbia Study classifications, but are possibly a little more specific.

The results of our classification are shown in Table VII. Only 14% of the children are in the Unsatisfactory category. These should be referred for clinical examination to determine the cause for the deviations in the grid. The combined Unsatisfactory and Doubtful categories amount to 39%—a result which is amazingly close to the British Columbia figure of 40.7% for their Unsatisfactory group. Although the latter survey gives no information regarding the children in the survey, they would obviously be quite dissimilar from those in our survey with regard to race, religion and socio-economic level. From personal observation, the results for the individual schools are what one would expect considering the type of children attending that school.

TABLE VII

CLASSIFICATION ACCORDING TO GRID FINDINGS

School	Satisfactory No.	%	Doubtful No.	%	Unsatisfactory No.	%	Total
Brant	31	63	12	25	6	12	49
Hester How	12	54	7	32	3	14	22
King Edward	83	62	30	22	22	16	135
Lansdowne	73	71	19	18	11	11	103
Ogden	51	68	18	24	6	6	75
Orde	41	60	14	21	13	19	68
Ryerson	69	60	27	23	20	17	116
Wellesley	29	59	12	25	8	16	49
Other schools	105	55	59	31	27	14	191
Total	494	61%	198	25%	116	14%	808

CLINICAL APPRAISAL AND AGREEMENT

The correlation of the grid findings and the clinical findings is an extremely important part of any study of the Wetzel Grid. Unfortunately, it is the weakest portion in our survey. Every child in the survey should have a complete physical examination to determine whether there is agreement with the classification according to the grid and also to determine the cause of unsatisfactory growth and development as shown by the grid. With the time and means at our disposal, it was possible to do this in only a cursory way. At the time of the last measurements (October and November, 1951), each

child was seen briefly, his medical records reviewed, and a rapid assessment of his apparent health and nutrition made. On this basis Table VIII was compiled.

As might be expected, there was good agreement in the Satisfactory group (88%), fair agreement in the Unsatisfactory group (69%), and poor agreement (38%) in the Doubtful group. With better physical examinations better agreement could undoubtedly be obtained. Many in the Satisfactory group were marked as having "enlarged" or "chronically inflamed" tonsils and other conditions which were of doubtful significance and possibly on further investigation could be shown to be quite normal. On the other hand, perhaps many who were Unsatisfactory on the basis of the grid findings but were apparently normal on clinical examination could, on more intensive investigation, be shown to be suffering from some condition, whether physical, emotional or nutritional, which was affecting their growth and development. The poor agreement found in "other" schools is due to the fact that these children were not seen by the medical officer, and the opinion regarding clinical status was based on the findings which were recorded on the A.D.P. cards, which were very incomplete.

TABLE VIII

Comparison of Grid and Clinical Findings

School	Grid Satisfactory			Grid Doubtful			Grid Unsatisfactory		
	No.	Clinical Agreement	% Agr.	No.	Clinical Agreement	% Agr.	No.	Clinical Agreement	% Agr.
Brant	31	29	94	12	9	75	6	5	83
Hester How	12	10	83	7	3	42	3	2	62
King Edward	83	74	89	30	11	36	22	19	86
Lansdowne	73	60	82	19	6	32	11	9	82
Ogden	51	45	88	18	8	44	6	6	100
Orde	41	33	80	14	5	36	13	8	62
Ryerson	69	63	90	27	15	56	20	16	80
Wellesley	29	20	68	12	6	50	8	7	88
Other	105	100	95	59	12	21	27	8	30
Total	494	434	88	198	*75	38	116	80	69

*In these 75, some condition was present which might account for the grid deviation.

Comments

Leeson, McHenry and Mosley,[7] in a small project in East York Township, found poor agreement between the grid findings and the physical status (59%) and nutritional status (56%) in a group of 359 children.

The report of the British Columbia Wetzel Grid Survey[3] states: "It has been seen that the grid screens into the Unsatisfactory group approximately 15 per cent for whom no malady can be detected on clinical examination. It does not, however, screen all pathology into this group, since it has been shown that 4.6 per cent of the entire group of school children studied were screened into the satisfactory category, notwithstanding the fact that they

had significant pathological defects." They also found that 7.8 per cent of the children screened as Satisfactory had significant pathology and that approximately 40 per cent of the children who were categorized Unsatisfactory according to the grid alone were found to be clinically fit.

Both reports stress the possibility of error on the part of the clinical examiner. The examination is largely subjective and is open to differences of opinion and interpretation. Stevenson, in "Recent Advances in Social Medicine,"[8] states: "It has been shown repeatedly that physicians disagree radically in assessing the nutritional status of children . . . Even more serious and discouraging has been the failure of physicians to be consistent in repeated assessments of the same child." If we accept these opinions, might not many of the children with Unsatisfactory grids, for which no clinical cause can be found, be actually suffering from a sub-clinical nutritional defect, undisclosed emotional disturbance, or other obscure condition?

In our group with Satisfactory grids, 12% were found to have defects. Some of these seem to be of a serious nature. For example, one case of chronic bronchiectasis and a couple of cases of heart disease were noted. In each of these, however, the condition had been known for some time and was under adequate supervision and treatment, the child responding and adapting himself so well that his growth pattern was normal.

No effort has been made in this survey to institute any recovery program or to assess the effect of any remedial measures which have been carried out.

To quote Chenoweth and Selkirk:[10] "The Wetzel Grid is an exceedingly simple procedure which is well adapted to school health work."

The simplicity of the method is well exemplified when it is compared with some of the other procedures recommended for assessing physical status and development. Franzen and Palmer[11] disregard height and weight, but measure arm girth, depth of chest and width of hips, which are compared with standard tables. Stuart and Meredith[12] measure height, weight, hip width, chest circumference, leg girth and thickness of two selected folds of skin and subcutaneous tissue. Meredith, in a more recent article,[13] has modified and simplified his original procedure and now uses charts as well as percentile tables. It has not been proven that these advanced anthropometrical measurements give any more accurate information regarding the physical or nutritional status of the child than does the Wetzel Grid. Similarly, the use of complicated mathematical calculations (such as the Tuxford Formula) are no more valuable and have the disadvantage of not being graphic.

No claim has ever been made that the Wetzel Grid is a substitute for clinical examination or for other methods of screening. It is merely a useful adjunct to the general school health program. If used in conjunction with other screening and referral methods, it should be quite valuable. It would help assess the importance of any defects found, showing whether or not the defect (such as enlarged tonsils) was affecting the child's physique and development. It would be useful in illustrating to the child and parents the effect of defects and deficiences and the result of a treatment or recovery program, thus increasing their interest in the problem. It might be useful in assessing the value of any

recovery program or remedial measures which have been instituted. Perhaps the grid might find its best use in following children who, as a result of clinical examination or other means, are found to be malnourished or to have defects which impair or threaten health.

It is important that the analysis and interpretation of the grids be done by a qualified person with proper experience in the method, not by the class-room teacher or other non-medical personnel. The grids themselves should be kept in the Health Service Room, not the class-room. They should be used by the physician or the nurse to illustrate the child's condition and progress to the teacher, parent or child, or as a basis for referral for clinical examination.

Summary

A three-year project to determine whether or not the Wetzel Grid would be a useful inclusion in the school health program in Toronto is described.

The results obtained are given and compared with those obtained elsewhere. They are found to be very close to those given in the report of the British Columbia Wetzel Grid study.

Classification of the grid findings is discussed. A method of categorization suitable for our use is described. The results of the classification by this method are given and compared with those obtained elsewhere. Good agreement is found.

An attempt was made to correlate the grid findings with the clinical findings. It was possible to do this only in a rough way, but the results obtained seem to attest to the value and accuracy of the grid. Clinical agreement in general is discussed briefly.

The grid is compared with other methods of assessing physical status and development and its value in a School Health Program discussed.

Conclusions

The Wetzel Grid, when properly used, is useful as a method of screening children for clinical examination, but has its limitations. It can be used for assessing the importance of apparent defects. It is a graphic method of illustrating a child's growth and development, thereby increasing his and his parents' interest in his health and welfare. It cannot be used as a substitute for clinical examination or for other screening procedures. It should not be used by inexperienced or unqualified personnel.

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The Incidence of Human Trichinosis in Canada

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TRICHINOSIS of man in Canada has received relatively little attention and the data that are available on the prevalence of the disease have been accumulated from the results of a small number of surveys and the report of an occasional localized outbreak of the disease. While routine hospital autopsies are performed for pathological evidence of a large number of diseases, little or no examination is made for the presence of trichina cysts. Then too, because of the variety of symptoms assumed by the disease, the physician is prone to overlook the possibility of trichina infection except in cases which give the classical text-book picture during a general outbreak. Hall[1] gives a list of 50 diseases and clinical conditions recorded in diagnoses for admission to hospital of patients later found to be suffering from trichinosis. Gould[2] points out that this varied symptomatology and clinical picture are readily understood if the possible widespread distribution of the parasites in the human body is realized. In his excellent text on the subject, he lists 57 common symptoms and signs and 68 uncommon symptoms due to trichinosis. These facts are surprising since, of the large number of nematodes recorded from man, *Trichinella spiralis* is considered one of the most important from the public health aspect.

A large proportion of the data given in this paper has been obtained from the literature, but further information has been added from two surveys conducted on human diaphragm material obtained from Ottawa, Ontario and Kamloops, British Columbia.

Review of Literature

In Canada widespread surveys have not been conducted nor has as large a section of the population been investigated as has been recorded in the United States. Wright in 1951[3] made the statement that the incidence of infection in all countries where surveys have been conducted is lower than in the United States. Wright *et al.*[4] in 1943 summarized the United States Public Health Reports on trichinosis. This survey covered 189 hospitals in 114 cities of 37 states. A total of 11,931 diaphragms was examined, 16.2% of which were positive. It was emphasized that the majority of the surveys were based only on the examination of the diaphragm and when other muscles have been examined the incidence of infection has been found to be much lighter. Gould

in 1945[5] found that when thorough investigations are made the incidence at autopsy has been as high as 36% and estimates, on a conservative basis, that 25% of the general population of the United States are infected, the majority of the cases being subclinical.

In Canada Sir William Osler, in 1870, first drew attention to the presence of cysts of trichina in one of the bodies in the dissecting room at the Toronto School of Medicine. Since that date a number of isolated cases of trichinosis have been reported. The Montreal General Hospital Pathology Reports for 1883–1895[6] list two positive cases of trichina for 919 autopsies. Meakins and Gervais[7] recorded a trichinosis outbreak in Montreal in 1935 in which one child died and six others of the family became ill. A further outbreak occurred in Montreal in 1938 and Gervais[8] recorded 68 people, mostly of German extraction, as being ill with trichinosis. In Hamilton, Ontario, 23 definite cases of trichinosis were diagnosed by Cecilioni[9] and Deadman[10] in 1940. In 1951 Stanyon[11] recorded 10 cases of trichinella infection which had occurred in the Sudbury area in the past few years. The first large survey was conducted from 1940 to 1943 by Cameron,[12] who examined 509 specimens of human diaphragm material from Montreal hospitals and found that 1.5% were positive for trichina. Kuitunen-Ekbaum[13] in 1941 examined 420 human diaphragms in Toronto and found 7 positive. In 1945, Brown and his associates[14] examined 195 Eskimos on Southampton Island, Northwest Territories, for trichinosis and found that 40% showed a positive skin test and 40% had sera giving a positive precipitin test. In 1953, Bourns[15] records an incidence of 4% from the examination of 400 human diaphragms collected from Vancouver hospitals.

Material and Methods

Over a period of three years (1949, 1950, 1951) this laboratory had the opportunity of examining human diaphragm material obtained at autopsy from two Canadian sources. A local Ottawa hospital supplied the material in the east and specimens from Kamloops, British Columbia, were forwarded from the west.

The Ottawa material was obtained in fresh condition and the Kamloops specimens were shipped to the laboratory with only the addition of 1% phenolized saline.

The diaphragms were examined both under a National Institute of Health-type compressorium and by the artificial digestion method. Where possible, a piece of diaphragm tissue approximately 2½ inches square (20 to 25 gm.) was ground up and placed in the digestion fluid at 37°C. for 12 to 24 hours. The fluid consisted of 7 c.c. of HCl and 10 gm. pepsin in 1 litre of water; 20 c.c. of solution was used for each gram of tissue.

Results

Of the 82 diaphragms examined from the Ottawa area, 6 (7.3%) were positive for *Trichinella spiralis.*

One hundred and sixty-nine diaphragms were examined from the Kamloops area and 11 (6.5%) were found infected with *T. spiralis.* While a number

of Indian and Chinese cases was amongst this total, no trichina were found in diaphragm material from these races. The age at death was from 12 years to 83 years, with the total number of specimens examined from males being approximately three times the number from females. Of the 11 positive specimens, 8 were from males and 3 from females. In all cases the infections were light, that is, there were less than 15 larvae per gram, and in nearly 50% of the cases the cysts were partially calcified. As reported by Wright *et al.*,[4] the incidence of infection was seen to increase with advancing years. The average age of death of the group was 58.8 years, with the average age at death of the positive cases being 65.7 years. It is obvious that repeated infections occurring throughout the years gradually build up an infection which can be detected in the laboratory.

It should be noted that both these surveys were based on examination of diaphragm muscle taken from routine necropsies without regard to the clinical or anatomical diagnosis.

TRICHINELLA SURVEY FINDINGS IN CADAVERS IN CANADA

Author	Year	Place	No. Cases	No. Positive	Per cent Positive
Cameron	1940–43	Montreal	539	8	1.5
Kuitunen-Ekbaum	1941	Toronto	420*	7	1.7
Poole	1949–50	Ottawa	82	6	7.3
Poole	1949–51	Kamloops	169	11	6.5
Bourns	1953	Vancouver	400	16	4.0

*Of this total, 300 were from 15-87 years and 120 were children up to 16 years, of whom 77 were 1 year or less in age. Therefore, a maximum of 343 cases are comparable to the other survey totals.

The above table does not take into account the isolated clinical cases that have been reported in Montreal,[7, 8] Hamilton,[9, 10] and Sudbury.[11]

SUMMARY

The author is not able to offer any explanation as to why the incidence of infection in the Ottawa and Kamloops areas should be higher than that of the Montreal, Toronto and Vancouver areas. Trichinosis is a sporadic disease and in Canada it has been shown to occur from coast to coast in animals such as the pig (Cameron[16] and Franks[17]), wild rats (Moynihan,[18] Franks,[19] Kuitunen-Ekbaum[20] and Poole[21]), and in the Canadian Arctic in the polar bear (Parnell[22] and Brown[23]). There is no reason to suppose that the parasite's distribution in humans is less widespread.

The number of the various surveys and clinical reports are too small for one to attempt to evaluate the results statistically, although it does appear that trichinosis has a relatively low incidence in humans in Canada. However, there is one important public health point that should be kept in mind—no effective therapeutic remedies are available at this time against human trichinosis. The only real method of prevention of trichinosis in man consists in educating him

to cook pork—and in the case of Indians and Eskimos, game meat—to a sufficient degree to destroy the parasite.

ACKNOWLEGMENTS

The author wishes to thank Dr. M. Klotz of the Ottawa Civic Hospital and Dr. F. Humphreys of the branch laboratory at Kamloops for their generous cooperation in arranging for the collection of specimen material. To the various physicians in both areas who made available clinical data and devoted extra time at the autopsies and hence made the survey possible, the author would like to express his sincere appreciation.

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Canadian Journal of Public Health

THE STATUS OF GAMMA GLOBULIN

AT THE ANNUAL MEETING of the American Public Health Association in Cleveland last October, Dr. William McD. Hammon reported on the use of gamma globulin in the attempt to prevent or modify attacks of poliomyelitis. The report related to observations on approximately 55,000 children. The findings resulted in plans being made by the National Foundation for Infantile Paralysis Inc., New York (the American "March of Dimes"), to provide for the trial of gamma globulin on a greatly extended basis during the 1953 season. Gamma globulin is costly to prepare and available only in limited quantity. A quantity sufficient for the preventive treatment of a child weighing approximately one hundred pounds is obtained from a blood donation of one pint.

Following the presentation of the initial findings last fall, plans for the immediate preparation of gamma globulin were presented to the Federal and Provincial Departments of Health by the Connaught Medical Research Laboratories. It was fortunate that the Laboratories had the scientific staff and also a supply of blood serum which had been stored from the second world war, being serum that was not satisfactory for use as dried human blood serum. With funds supplied by the Federal and Provincial Departments, through the National Health Grants, special equipment and facilities were provided and the cost of production was met. Briefly, the achievement has made possible the preparation of the maximum quantity. In the undertaking, the Laboratories expedited in every way the preparation of gamma globulin, operating night and day. Great credit is due to Dr. Arthur Charles and Mr. K. A. B. Degen, who adapted methods and made possible the preparation of the product within the very short time available.

In planning the use of the very limited quantities of serum, it was felt that a small clinical advisory committee should function and assist the Federal Department in arranging for the distribution of gamma globulin. It was agreed that the distribution would be made to Provincial Health Departments, for use where the disease was epidemic. In a number of Provinces no serum has been required, and the available supplies have been used where the need has been

most urgent. In the United States the supplies were distributed to the various State Departments of Health and the serum has been used, as far as possible, in ways which would permit the obtaining of valuable information. One hundred and fifty thousand children have received gamma globulin in nine widely scattered mass inoculations east of the Mississippi. The first of these was in Montgomery County, Alabama, where by July 3rd more than 30,000 children under ten years had received serum. It is too early to judge the effectiveness of these inoculations, but the preliminary results are encouraging.

It would seem that in the absence of a specific preventive vaccine, gamma globulin has value in preventing poliomelitis if used sufficiently early following exposure. The protection lasts for four to six weeks. It is obvious that the use of gamma globulin does not constitute a practical method of controlling poliomyelitis. In view, however, of the seriousness of the disease and the measure of encouragement that has been obtained in the work this year, plans are being made in the United States for the collection of larger quantities of human blood and the continued preparation of gamma globulin for use in the season of 1954.

If the results warrant the use of gamma globulin, the Federal and Provincial health authorities, with the Canadian Red Cross Society and the facilities of the Connaught Medical Research Laboratories, will make plans for meeting the needs of 1954. The trials that have been possible during the present outbreak of poliomyelitis in several of the Provinces will be helpful in the evaluation of gamma globulin.

DR. D. BRUCE WILSON RETIRES

CANADA HAS CONTRIBUTED to international public health a number of leaders whose work has been outstanding. The story of the conquest of yellow fever is a thrilling one. Dr. D. Bruce Wilson is one of the Canadians who gambled with death in the conquest of this disease. On June 30th he completed his active service with The Rockefeller Foundation's Division of Medicine and Public Health. He had been associated with the Foundation since 1920, when he joined the field staff.

Dr. Wilson, who was born at Merrickville, Ontario, graduated from the University of Toronto in arts in 1916 and in medicine in 1920, having interrupted his studies to serve with the Navy in World War I. Following a year as county health officer for North Carolina and New Mexico, in 1920-21, he engaged for six years in hookworm control in Spanish Honduras and Colombia. In 1928 he was assigned to Brazil, with special responsibilities for yellow-fever studies and control. During the next ten years, from 1930 to 1940, he was concerned with the eradication of *Anopheles gambiae* from that country. Few men in the Foundation have undertaken such a continuous program of service in the tropics, dealing in turn with hookworm, yellow fever, and malaria. He was the first person to receive yellow-fever vaccine. On the completion of his work in South America, he was appointed regional director for Africa and the Middle East. In World War II he served as consultant to the Surgeon-General

of the United States Army, in the Near East, and at the end of the war he became the Foundation's regional director for the Near East. In 1950 he returned to Canada as the Foundation's representative, succeeding Dr. William A. McIntosh, with whom he had been associated in 1942 and 1943 in a survey of the public health services of the City of Halifax, the City of Sydney, and the Island of Cape Breton. During the past three years Dr. Wilson has carried forward the program of the Division of Medicine and Public Health.

In recognition of his contributions in various fields, Dr. Wilson has been awarded the Southern Cross, Brazil; the Order El Maaref, Egypt; the Gambiae Medal, and the Cholera Medal.

His many friends in Canada will be pleased to know that Dr. Wilson is not retiring from public health work, but has accepted an appointment as medical officer of health for Swansea, a suburb of Toronto.

ROBERT D. DEFRIES,
C.B.E., M.D., D.P.H.

Director, Connaught Medical Research Laboratories and School of Hygiene, University of Toronto, and President, Canadian Public Health Association.

JOHN HOWIE,
M.D., C.M., D.T.M., D.P.H.

Medical Officer of Health, Windsor, Ontario, and President, Ontario Public Health Association.

CANADIAN PUBLIC HEALTH ASSOCIATION
FORTY-FIRST ANNUAL MEETING

ONTARIO PUBLIC HEALTH ASSOCIATION
FOURTH ANNUAL MEETING

ROYAL YORK HOTEL, TORONTO
OCTOBER 1 – 3, 1953

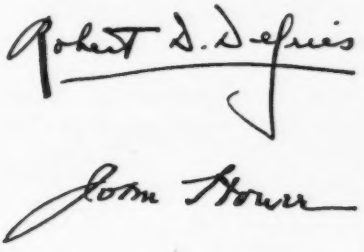
THE PAST YEAR has been an important one in the development of the Canadian Public Health Association. Provincial public health associations are now functioning across Canada, as divisions of the national organization. The forty-first annual meeting, to be held in conjunction with the Ontario Public Health Association, marks another milestone in the Association's progress.

Today the public health program is changing to meet the changing needs of the community. The frontiers of public health are expanding and new types of programs are being introduced. Medical research is providing methods for the more effective control of tuberculosis, poliomyelitis, and other diseases. New interest in the problem of chronic disease is evident, and there is a growing recognition that the health department has a responsibility in this field. Additional financial assistance for public health work is being provided through the introduction of three new health grants by the Government of Canada, for child and maternal health services, medical rehabilitation, and laboratory and radiological services.

The national meeting of the Association is the occasion when public health workers from every Province confer on today's needs in public health and plan for the future. It is the responsibility of every public health worker who can possibly do so to participate in the national meeting, and to take advantage of the opportunity to learn of the work that is being undertaken in all parts of Canada. The interests of everyone who is contributing to public health will be the concern of the Executive Council in its sessions on Wednesday, September 30, preceding the annual meeting.

In addition to an outstanding program, the local committee is planning entertainment for the ladies, and there will be a post-convention trip to Niagara Falls on Saturday, October 3.

A most cordial welcome awaits you.



DIRECTORY OF SESSIONS

Wednesday, September 30

2.15 p.m.—Executive Council, Canadian Public Health Association. Private Dining Room No. 7.

8.15 p.m.—Executive, Ontario Public Health Association. Private Dining Room No. 6.

Thursday, October 1

8.30 a.m.—Registration. All delegates are expected to register. The fee is $2.00 for members and $4.00 for non-members (covering membership for 1954 as well as the registration fee for this meeting). Convention Foyer.

9.30 a.m.—Section Meeting: **Public Health Nursing.** Library.

10.00 a.m.—Minister's Conference. Concert Hall.

10.00 a.m.—Section Meetings:
Sanitation. Private Dining Room No. 10.
Vital & Health Statistics and Epidemiology. Private Dining Room No. 8.

12.50 p.m.—Luncheon. Tudor Room. Tickets ($2.50, including gratuity) are on sale at the Registration Desk. Speaker: The Hon. PAUL MARTIN, Minister of National Health and Welfare.

2.15 p.m.—Section Meetings:
Health Officers, Public Health Nursing, and Dental Public Health. Concert Hall.
Public Health Education. Private Dining Room No. 10.
Veterinary Public Health. Library.

3.00 p.m.—Conducted tour and tea for ladies, the Art Gallery of Toronto.

7.00 p.m.—Annual Dinner. Ballroom. Tickets ($4.00, including gratuity) are on sale at the Registration Desk. Speaker: EDWARD G. McGAVRAN, M.D., M.P.H., Dean of the School of Public Health, University of North Carolina; and Chairman of the Board of Editors, *Public Health Reports*, U.S. Department of Health, Education, and Welfare.

Friday, October 2

9.15 a.m.—General Session. Ballroom.

12.15 p.m.—Luncheon. Parlour A. Tickets ($2.50, including gratuity) are on sale at the Registration Desk. Speaker: M. R. ELLIOTT, M.D., D.P.H., Deputy Minister of Health, Province of Manitoba.

2.15 p.m.—Section Meetings:
Health Officers and Sanitation. Ballroom.
Public Health Education and Public Health Nursing. Library.
Dental Public Health. Private Dining Room No. 10.
Vital and Health Statistics. Private Dining Room No. 8.

Saturday, October 3

Post-Convention Visit to Niagara Falls.

Preliminary Program

Wednesday, September 30, 2.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
Meeting of Executive Council
Private Dining Room No. 7

Presiding: ROBERT D. DEFRIES, M.D., D.P.H., Director, Connaught Medical Research Laboratories and School of Hygiene, University of Toronto, and President of the Canadian Public Health Association.

Wednesday, 8.15 p.m.

ONTARIO PUBLIC HEALTH ASSOCIATION

Meeting of the Executive

Private Dining Room No. 6

Presiding: JOHN HOWIE, M.D., D.P.H., Medical Officer of Health, Windsor, and President of the Ontario Public Health Association.

Thursday, October 1, 8.30 a.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION

REGISTRATION

Convention Foyer

Everyone is expected to register. The fee is $2.00 for members and $4.00 for non-members—covering membership for 1954 as well as registration for this meeting. **Please bring your 1953 membership card with you.** Wives of delegates register without charge.

Thursday, 9.30 a.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION

Section of Public Health Nursing

Library

Presiding: MISS BRIGITTE LALIBERTE, R.N., Chief Nurse, Department of Health of Montreal, and Chairman of the Public Health Nursing Section, Canadian Public Health Association.

Relaxation in Preventive Medicine:
R. G. BELL, M.D., Medical Director, Shadow Brook Health Foundation, Ltd., Toronto.
MISS DOROTHY CLARKE MADGETT, Physiotherapist T.M.E., Demonstrator in Anatomy, Faculty of Medicine, University of Toronto.

The Plans for Relaxation and Physical Preparation for Childbearing, in connection with the Toronto Welfare Council's Prenatal Classes.
MISS RUTH WATSON, Reg.N., Superintendent's Assistant, Toronto Branch, Victorian Order of Nurses.

Thursday, 10.00 a.m.

MINISTER'S CONFERENCE FOR ONTARIO HEALTH PERSONNEL

Concert Hall

Presiding: JOHN HOWIE, M.D., D.P.H., Medical Officer of Health, Windsor, and President of the Ontario Public Health Association.

Presidential Address.
JOHN HOWIE, M.D., D.P.H.

Appointment of Nominations and Resolutions Committees.

Minister's Conference—The Honourable MACKINNON PHILLIPS, M.D., Minister of Health.
Recent Changes in Health Legislation.
Question-and-Answer Period.
Open Discussion of Current Problems.
Other Business.

Thursday, 10.00 a.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION

Sanitation Section

Private Dining Room No. 10

Presiding: MR. T. H. JACKSON, C.S.I.(C.), Chief Quarantine Officer, Department of Public Health, City of Toronto, and Chairman of the Section.

The Interpretation of the Cemetery Act.
G. A. H. BURN, Division of Sanitary Engineering, Department of Health for Ontario, Toronto.

Lighting.
Speaker to be anounced.

Thursday, 10.00 a.m.

CANADIAN PUBLIC HEALTH ASSOCIATION

Sections of Vital and Health Statistics and Epidemiology
Private Dining Room No. 8

Presiding: MR. T. E. ASHTON, Director of Vital Statistics, Department of Public Health, City of Toronto, and Chairman of the Vital and Health Statistics Section.

The Interpretation of the Tuberculin Test in a BCG Program.
CHESTER B. STEWART, M.D., M.P.H., Professor of Epidemiology, Dalhousie Universitv. Halifax.

Public Health Statistics in Air-Pollution Studies.
GORDON H. JOSIE, M.P.H., Research Division, Department of National Health and Welfare, Ottawa.

Measles in the Canadian Arctic, 1952.
A. F. W. PEART, M.D., D.P.H., Chief, Epidemiology Division; and F. P. NAGLER, M.D., Laboratory of Hygiene, Department of National Health and Welfare, Ottawa.

Incidence of Mental Disorders.
G. E. HOBBS, M.D., Professor of Clinical Preventive Medicine, The University of Western Ontario, London.

Thursday, 12.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION

LUNCHEON
Tudor Room

Speaker: THE HONOURABLE PAUL MARTIN, Minister of National Health and Welfare.

Tickets ($2.50, including gratuity) are on sale at the Registration Desk. Early purchase is essential, as the accommodation is limited to 125.

Thursday, 2.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION

Combined Section Meeting: Health Officers, Public Health Nursing, and Dental Public Health
Concert Hall

Presiding:

L. A. CLARKE, M.D., D.P.H., Medical Officer of Health, Hamilton, and Chairman of the Health Officers Section, Ontario Public Health Association.

MISS HELEN FASKEN, Director of Public Health Nursing, Wellington County Health Unit, Fergus, and Chairman of the Public Health Nursing Section, Ontario Public Health Association.

GLENN T. MITTON, D.D.S., D.D.P.H., Dental Public Health Department, University of Toronto, and Chairman of the Dental Public Health Section, Ontario Public Health Association.

Full-Time Health Services in Quebec.
PAUL CLAVEAU, M.D., D.P.H., Chief, Division of County Health Units, Ministry of Health, Province of Quebec.

Public Health Aspects of Fluoridation.
G. NIKIFORUK, D.D.S., M.Sc., Associate Professor of Paedodontics and Research Associate in Biochemistry in the Division of Dental Research, Faculty of Dentistry, University of Toronto.

Maternal and Child Care.
JEAN F. WEBB, M.D., D.P.H., Acting Chief, Division of Child and Maternal Health, Department of National Health and Welfare, Ottawa.

Medical Care in Relation to Public Health.
G. H. HATCHER, M.D., D.P.H., Assistant Professor of Public Health Administration, School of Hygiene, University of Toronto.

Thursday, 2.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION

Public Health Education Section
Private Dining Room No. 10

Presiding: PIERRE DE LEAN, M.P.H., Division of Health Education, Ministry of Health of the Province of Quebec, Montreal, and Chairman of the Section.

Program to be announced.

Thursday, 2.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION

Veterinary Public Health Section
Library

Presiding: DAVID GARRICK, V.S., D.V.P.H., Veterinarian, Simcoe County Health Unit, Barrie, and Chairman of the Veterinary Public Health Section, Ontario Public Health Association.

Rabies and Other Diseases of Interest to the Public Health Veterinarian.
CHAS. A. MITCHELL, D.V.M., Chief, Division of Animal Pathology, Federal Department of Agriculture, Hull, Quebec.

The Public Health Veterinarian in the Canadian Army.
NORMAN SANDERSON, D.V.M., D.V.P.H., Veterinarian attached to the Army Medical Staff, Ottawa.

The World Health Organization and its Activities in Veterinary Public Health.
EARL CHAMBERLAYNE, B.V.Sc., D.V.P.H., Veterinary Public Health Consultant, World Health Organization—Pan American Sanitary Bureau, Washington.

Veterinary Public Health in Ontario—A Summary.
G. A. EDGE, V.S., D.V.M., D.V.P.H., Officer in Charge of Food Sanitation, Department of Health of Ontario, Toronto.

Election of Officers for 1953-1954.

Thursday, 7.00 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION

Annual Dinner
Ballroom

Presiding: R. D. DEFRIES, C.B.E., M.D., D.P.H., President of the Canadian Public Health Association.

Address.
EDWARD G. McGAVRAN, M.D., M.P.H., Dean of the School of Public Health, University of North Carolina; and Chairman of the Board of Editors, *Public Health Reports*, U.S. Department of Health, Education, and Welfare.

Introduction of MR. THEO. J. LAFRENIERE, C.E., Chief Engineer of the Ministry of Health, Province of Quebec, President of the Canadian Public Health Association for 1953-1954.

Tickets ($4.00, including gratuity) are on sale at the Registration Desk. They will not be available at the door, but must be purchased in advance. The accommodation is limited to 150.

Friday, October 2, 9.15 a.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION
General Session
Ballroom

Presiding: JOHN HOWIE, M.D., D.P.H., Medical Officer of Health, Windsor, and President of the Ontario Public Health Association.

Presidential Address.
R. D. DEFRIES, C.B.E., M.D., D.P.H., Director, Connaught Medical Research Laboratories and School of Hygiene, University of Toronto, and President of the Canadian Public Health Association.

Are Dental Public Health Programs Worth While?
PHILIP E. BLACKERBY, Jr., D.D.S., M.P.H., Director, Division of Dentistry, W. K. Kellogg Foundation, Battle Creek, Michigan.

A Program for Maternal Care.
DOUGLAS E. CANNELL, M.B., B.Sc.(Med.), F.R.C.S.(C.), Professor of Obstetrics and Gynaecology, University of Toronto, and Gynaecologist, Toronto General Hospital.

Title to be announced.

Reports of Committees on Resolutions, Canadian and Ontario Public Health Associations.

Friday, 12.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION
Luncheon
Parlour A

Presiding: JOHN HOWIE, M.D., D.P.H.

Address: M. R. ELLIOTT, M.D., D.P.H., Deputy Minister of Health, Province of Manitoba, and Past-president, Canadian Public Health Association.

Reports of Committees on Nominations, Canadian and Ontario Public Health Associations.

Tickets ($2.50, including gratuity) are on sale at the Registration Desk. Early reservations are essential, as the accommodation is limited to 100.

Friday, 2.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION
Health Officers and Sanitation Sections
Ballroom

Presiding: L. A. CLARKE, M.D., D.P.H., Medical Officer of Health, Hamilton, and Chairman of the Health Officers Section, Ontario Public Health Association; and T. H. JACKSON, C.S.I.(C.), Chief Quarantine Officer, Department of Public Health, City of Toronto, and Chairman of the Sanitation Sections in the Canadian and Ontario Public Health Associations.

The Importance of Sanitation as a Virologist Sees the Problem.
C. E. van ROOYEN, M.D., M.R.C.P.(Lond.), Professor of Virus Infections, University of Toronto.

Air Pollution in Relation to Health.
D. Y. SOLANDT, M.D., D.P.H., F.R.S.C., Professor of Physiology; Professor and Head of the Department of Physiological Hygiene, University of Toronto.

The Ontario Course in Sanitary Inspection.
MAJOR A. S. O'HARA, M.R.San.I., C.S.I.(C.), Consultant in Sanitation, Division of Sanitary Engineering, Department of Health for Ontario, Toronto.

Friday, 2.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION

Dental Public Health Section
Private Dining Room No. 10

Presiding: GLENN T. MITTON, D.D.S., D.D.P.H., Dental Public Health Department, University of Toronto, and Chairman of the Dental Public Health Section, Ontario Public Health Association.

Friday, 2.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION
and
ONTARIO PUBLIC HEALTH ASSOCIATION

Sections of Public Health Education and Public Health Nursing
Library

Presiding: MISS HELEN FASKEN, Reg.N., Director of Public Health Nursing, Wellington County Health Unit, Fergus, and Chairman of the Public Health Nursing Section, Ontario Public Health Association.

Symposium: HEALTH EDUCATION

Chairman: WILLIAM MOSLEY, M.D., D.P.H., Director, East York—Leaside Health Unit, Ontario.

Participants:

J. GILBERT, M.D., M.P.H., Secretary, School of Hygiene, University of Montreal, and Director, Division of Health Education, Ministry of Health of Quebec.

D. V. CURREY, M.D., D.P.H., Director, St. Catharines—Lincoln Health Unit, St. Catharines.

MISS M. MacLACHLAN, Lecturer, School of Nursing, University of Toronto.

MRS. G. PURCELL, Director of Public Health Nursing, East York—Leaside Health Unit, Ontario.

MISS M. CAHOON, B.Ed., Public Health Educator, East York—Leaside Health Unit, Ontario.

Friday, 2.15 p.m.

CANADIAN PUBLIC HEALTH ASSOCIATION

Section of Vital and Health Statistics
Private Dining Room No. 8

Presiding: MR. T. E. ASHTON, Director of Vital Statistics, Department of Public Health, City of Toronto, and Chairman of the Section.

Observations on Mortality from Lung Cancer in Canada.
J. WYLLIE, M.D., D.P.H., Professor of Preventive Medicine, Queen's University, Kingston.

Volume of Hospital Cases and of Surgical Operations in Relation to Supply of Hospital Beds.
G. W. MYERS, C.A., Executive Director, Saskatchewan Hospital Services Plan, Regina.

Election of Officers for 1953-54.

Saturday, October 3—9.00 a.m.

POST-CONVENTION TRIP TO NIAGARA FALLS
Details will be published in the final program.

PROGRAM COMMITTEE

DR. R. D. DEFRIES DR. A. R. J. BOYD MISS HELEN CARPENTER
DR. D. S. PUFFER DR. WILLIAM MOSLEY

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Dental Public Health: Program Chairman—DR. R. A. CONNOR, Grimsby

Health Officers: Chairman—DR. D. G. H. MacDONALD, Brampton
Secretary—DR. G. L. ANDERSON, Sarnia